The MAC Flyer

SEPTEMBER 1974

Our Magellan. Page 3.

MILITARY AIRLIFT COMMAND
GEN PAUL K. CARLTON Commander
LT GEN DANIEL JAMES, JR. Vice Commander
BRIG GEN JOHN H. GERMERAAD Inspector General
COL EMERY J. CRANE Director of Safety

The MAC Flyer

For Greater Efficiency
in MAC Air Operations

THE STAFF
LT COL JOHN W. RAY Supervising Editor
MAJ GEORGE D. BURGESS Associate Editor
CAPT ALBERT R. BARBIN, JR. Associate Editor
ISOBEL M. BRYANT Managing Editor
TSGT EUGENE REECE Art Director

SEPTEMBER 1974 MAC RP 127-5 VOL XXI, NO. 9

6

10

24

Our Magellan 3
"Minimums — Runway in Sight" 6
Good Show 9
When Push Comes to Shove 10
Letters to the Editor 13
Shakey's Alive and Flying in the ANG 14
Aircrew Fatigue = Skill Deterioration 16
Global Notes 19
Signature in the Sky 20
C. R. Terror 24
The Way the Winds Blow 27
Quick Stoppers 28

COVER: The modern jet contrasts sharply with the ancient sailing ship. The similarity — a navigator to show the way.

The MAC Flyer is published by the Directorate of Safety, HQ MAC. The contents are informative and not regulatory or directive. All names in accident stories are fictitious and no information concerning aircraft accidents may be construed as incriminating under Article 31, UCMJ.
Contributions, comments, and criticisms are welcome. Write: The Editor, The MAC Flyer, MAC/IGFE, Scott AFB, IL 62225, or call: (618) 256-3534, Autovon 638-3534. The Editor reserves the right to change manuscripts to improve them or correct technical errors.
The magazine is available from: The Superintendent of Documents, Government Printing Office, Washington, DC 20402. Price 50 cents per copy, $5.25 per year ($6.60 foreign).
Distribution F, X; OPR MAC/IGFE.

Our Magellan

by Maj Arthur Covello
514 MAW (Assoc)
McGuire AFB, N.J.

Those who seem to know all are sometimes the ones to watch closely.

It was my turn to sleep. The flight to the Middle Eastern base had been long, and now it was Our Magellan's turn at the panel as we nosed toward the Misty Isles for the return trip.

Our Magellan had assured us he was quite an expert on this route, having flown it a number of times. It was "a piece of cake." Our crew, he had told the aircraft commander, was really fortunate to get an augmentee navigator who was so highly skilled.

His skills, apparently, extended to other crew positions. As we climbed into the darkness, O.M. was telling the flight engineer to check the generators. He didn't think they were operating right. The loadmaster was told that he should have reconfigured the load before we took off. Naturally, O.M. had logged many hours in the left seat of the C-141. His fluency in "pilot talk" was quite impressive.

Settling into the ACM seat, I wished that I, too, could communicate so easily with the other technicians on my crew. Talk of EPRs, center of gravity, and moments, always dazzled me. But

Our Magellan

then, I found it difficult to comprehend "sidereal day" and "microsecond delays." From time to time, I even panicked when confronted with HOMOTO. (A mental shortcut used by navigators to help them remember the formula for plotting a line of position.)

O.M.'s prattle with the other crew members on interphone weighed heavily on my eyelids as well as my ears. Morpheus was taking over as we entered European airways before coasting out for the Misty Isles. With O.M. in the seat, what could go wrong?

I awoke as we were about to coast out. The amber evil eye indicating a doppler committing things to memory caught my attention as it flickered on and off — but mostly on. O.M. seemed unconcerned as he bantered with the pilots about Cat I and Cat II landings. I noted that the sextant remained asleep in its fiberglass bed.

Feeling very grubby, I tried to rub the sleep from my eyes. I looked around from the uncomfortable ACM seat to view what was happening. Apparently, the

A quick check on O.M. showed some glaring errors.

doppler, in its present condition, alone with the ASN 24, were to take us to the Misty Isles, still some two hours away.

Our Magellan was in the middle of telling a joke when I suggested, in my most convincing manner, that I could put the sextant up and take a shot for him if he'd like. He didn't think it absolutely necessary, but concurred that I could if I wanted to, and he would store the data in the ASN 24 celestial panel. There were just no other navigation aids in this region.

I kept asking myself why I was volunteering my services when I had already done my bit. I remembered reading about a C-54 in the 1950s that completely missed the Misty Isles and ended up making a soft landing in the drink. Then I decided the comfort of a BOQ bed might feel better than the water bed commonly called a life raft — even if the entire Atlantic Ocean was its mattress.

After determining which three stars would give us good cuts, I went up to shoot Dubhe, first. Aligning the cross hair and bubble on the star, which was off our right wing, I found it almost a full degree higher than the read-out on the ASN 24 panel.

"This can't be right!" I shouted over the din of the four powerful engines that depended on a limited supply of gas for life.

"Let's check it again," said O.M., as he began thumbing through the almanac once more.

"Looks good," he exclaimed. I agreed — the GHA of Aries was stored correctly.

By this time, our aircraft commander, hearing the commotion, climbed languidly down from the top bunk where he had been asleep. "What's wrong? Where are we?" he asked. I didn't have the heart to tell him. I'd wait until he was fully conscious.

I shot the three star, then double checked course with latitude by Polaris. O.M. plotted it. We were 56 miles north of course — and only 35 minutes from our last positive fix!

But no — wait! Glancing at the computer flight plan, then to his chart, O.M. made a discovery. He had not plotted his course but was, instead, using an old one drawn on the chart from another mission. This old course was considerably south of where we wanted to go. But, even after plotting the correct course, we were still more than 30 miles off course.

The aircraft commander, watching the scenario, was fully awake by now and whispering nervously in my ear, "Watch him! Watch him, will you!"

"I am! I am!" I responded, hiding my fright with downcast eyes and moving off to the darkened recess of the cabin.

I watched O.M. update the computer. Nevertheless, I couldn't rest, so I shot two more fixes as rapidly as I could.

I finally relaxed again when the Misty Isles relieved my anxiety by coaxing the number one needle to point to the inbound course and radial.

O.M. shrugged it all off. "Well, I've never seen a doppler like this one. It would have been simple with decent equipment," he emphasized.

I slumped back into the ACM seat. It felt comfortable for a change. I was dreaming of a beer and a bed, when, awakening in a fright and in a cold sweat, I heard the copilot announce, "One hundred above."

Why did I let it happen: O.M. was monitoring the letdown!

ABOUT THE AUTHOR

Maj Covello entered the Air Force in 1952 following graduation from St. John's University. After finishing navigator school, he had a variety of assignments in RB-26s, C-119s, KC-97s, and O-2s. He was an AFROTC instructor at Kenyon College, Ohio and received a masters degree from Incarnate Word College, San Antonio, Tex. Maj Covello left active duty in 1970 to join the Associate Reserves at McGuire AFB, N.J.

"Minimums —

"The highest susceptibility for a landing approach accident exists in reduced visibility conditions during a nonprecision approach. A gap exists in visual vertical guidance between the time the approach lights become visible and the time the end of the runway is sighted." David D. Thomas, president, Flight Safety Foundation. Taken from a Special Study Report on Approach and Landing Accident Prevention Forum (National Transportation Safety Board Report Number NTSB-AAS-73-2).

Military and commercial aircraft sometimes operate into airports not equipped with vertical reference or glide path equipment. Prevailing weather at these airports often requires precise altitude interpretation when executing what is appropriately known as a nonprecision approach.

Pilots occasionally start nonprecision approaches in weather that not only is barely legal, but which stretches their skill with a stacked deck of illusionary visual cues, sloping terrain, little glide slope information, and inadequate course guidance. Knowledge, experience, and cockpit discipline in such demanding approach environments can mean the difference between a safe approach and a catastrophe just short of the field.

In the Ball Park

A nonprecision approach is an instrument procedure which permits an orderly transition from

Runway in Sight"

Low ceilings, lousy vis, and broad course tolerances make the nonprecision approach a sporty event.

enroute navigation facilities to a point at or near an airport. From this point a pilot must make a visual approach and landing. Sounds simple. But the real kicker in nonprecision approaches is the absence of electronically transmitted glide path or vertical reference signals. Without glide path reference, the pilot must determine his own descent profile to the runway. This determination is a most important factor in the approach and may be distorted by adverse visual cues.

Initial approach fix altitudes, procedure turn altitudes, and minimum descent altitudes are designed with a planned descent profile in mind. But one piece of altitude information, the minimum descent altitude (MDA), bares close scrutiny. MDA is an altitude, specified in feet above mean sea level, below which descent will **not** be made until visual reference has been established with the runway environment and the aircraft is in a position to make a "normal" landing. Well, what kind of approach is required for a "normal" landing?

Generally, in fixed wing aircraft, a "normal" landing is one flown from a 2 to 3 degree glide path angle. But aligning an aircraft vertically for such an approach after breaking out at MDA can take some doing. After passing the final approach fix, the pilot descends to MDA, and looks for and aligns the aircraft with the runway. And this may take time. A prompt descent after the final approach fix will hopefully get you out of the weather quickly and give you time to establish visual reference with the runway environment as soon as possible.

A comfortable rate of descent from final approach fix altitude down to MDA is about 1,000 to 1,200 feet per minute in most MAC aircraft. At this rate, an aircraft departing a 2,400 foot final approach fix altitude six miles from the runway at 120 knots (ground speed) will level at a 400-foot MDA approximately two miles, or one minute, from touchdown. MDA's are normally 300 to 600 feet above the runway touchdown zone elevation and should be closely monitored throughout final until weather and visibility permit a visual landing. A little cockpit inattention or momentary distraction could precipitate an insidious descent that will quickly reduce the meager altitude pad between airplane and ground.

Long, dragged-in approaches may sometimes be necessary due to the instrument approach profile and location of ground navigation equipment. Normally, aircraft landing configurations are completed at the final approach fix. But while extended landing flaps and slats increase lift and help slow the aircraft to a stabilized approach speed, this is not achieved without a price — drag, and lots of it.

Drag produced by lift augmentation, high angles of attack, speed brakes, and landing gear require high power setting during level flight. Descending to MDA is a fairly easy maneuver, but leveling off can be quite another story if the pilot is not prepared. On most jet transports, engines should be kept spooled-up during the descent and throttles advanced just prior to MDA. This is necessary to arrest the descent and to offset inertia gained by the aircraft during the descent. You could fly right on through your MDA if level-off is started before power is advanced.

Down to the Runway

When the copilot calls "Minimums . . . runway in sight," the natural tendency for any pilot is to resume descent down to security of the runway. But unless the MDA is unusually high, you should resist this tendency! Minimum descent altitudes provide little room below in which to maneuver. A resumption of descent three or four miles out (on final approaches with low MDA's) would be premature. A hardly noticeable 200 foot per minute descent begun five miles (120 knots) from the runway at an altitude equal to a 400-foot HAT, would place an aircraft in the brush or housing area about one mile short. If the landing runway happens to be equipped with a VASI, the pilot has won a three-star jackpot because he now has

"Minimums – Runway in Sight"

positive glide path assistance. But many runways have no VASI.

DME as an Aid

Runways without VASI equipment present the original problem — how to gage glide path, descent points and descent rates. Runway dimensions, lighting, and weather conditions make determining distance and proper rate of descent difficult. But cockpit distance measuring equipment (DME) can help you set up the 2.5 degree glide path angle we most often fly.

The MDA, runway touchdown zone elevation, and an accurate DME reading to the end of the runway can be used to compute a desired glide slope. But who has time on final approach to go through trigonometric gyrations?

For quick reference, figure 1 shows glide slope angles for MDA's with various HAT's from varying mileages (based on touchdown 1,000 feet down the runway). For example, after leveling off at an MDA with a 300-foot HAT, the point at which to begin descent to attain a 2.4 degree glide path is one mile from the runway. Figure 2 plots glide slope angles and touchdown points at one mile from the useable runway.

You can see from the two figures that glide slope angles shallow out appreciably at nearly all of the listed altitudes beyond one nautical mile. Resumption of descent to the runway from a point farther out than one mile is likely to place your aircraft at an unsafe altitude with the landing gear uncomfortably close to the ground. On the other hand, if you resume descent from altitudes of 300-350 feet above the touchdown zone at a distance of one mile from the end of the usable runway (plus 1,000 feet to touchdown) your glide slope angle will approximate the desired 2.5 degrees. A look at the one mile glide slope data in figure 2 shows glide slope gradients for these and other altitudes. When using DME, pay careful attention to the location, distance, and direction of tacan/DME equipment when figuring this "one mile point."

GLIDE SLOPE ANGLES TO RUNWAY TOUCHDOWN FROM VARIOUS DISTANCES*

Altitude	1NM	2NM	3NM	4NM	5NM
500 ft	4.0°	2.2°	1.5°	1.1°	0.9°
450 ft	3.6°	1.9°	1.4°	1.0°	0.82°
400 ft	3.2°	1.7°	1.2°	0.9°	0.73°
350 ft	2.8°	1.5°	1.1°	0.8°	—
300 ft	2.4°	1.3°	0.9°	0.67°	—

*Based on a touchdown point 1,000 foot from the approach end of the runway.

FIGURE 1

GLIDE SLOPE ANGLES TO RUNWAY TOUCHDOWN FROM ONE NAUTICAL MILE

Final App Altitude	500 ft*	1,000 ft*	1,500 ft*	2,000 ft*
500 ft	4.3°	4.0°	3.7°	3.5°
450 ft	3.9°	3.6°	3.4°	3.2°
400 ft	3.5°	3.2°	3.0°	2.8°
350 ft	3.0°	2.8°	2.6°	2.5°
300 ft	2.6°	2.4°	2.3°	2.1°

*Touchdown points from the approach end of the runway.

FIGURE 2

VOR and NDB

Defining "the one mile point" on VOR, NDB, and localizer only approaches is difficult at best, but here are a few suggestions: Many DOD nonprecision approach plates contain time and distance data from the final approach fix to the missed approach point. One mile from the end of the runway can be estimated by precomputing elapsed time from the final approach fix, assuming the missed approach point is near the end of the runway. For instance, if the distance from final approach fix to missed approach point is four miles and the approach speed (ground speed) is 120 knots, then time to missed approach is 2 minutes. Therefore, time to the one mile point is 1 minute, 30 seconds. Varying airspeed, wind gusts, and oddball distances and times may make such a computation a headache without an IBM computer. But even a rough timing estimate can make the going a little easier when the time comes to descend to the runway.

The name of the game is to establish a familiar descent profile in order to minimize high powered, dragged in low approaches over unhospitable real estate. Aiming toward a "window" 300 to 350 feet above the runway touchdown zone at one mile from the runway should help position the aircraft for a "normal" landing.

While these suggestions are simply techniques, using them as a "rule of thumb" could help make your next "nonprecision" approach a little more precise.

Capt Lazaro

Capt Robert A. Lazaro

GOOD SHOW

Capt Robert A. Lazaro, Det 8, San Francisco University (ROTC), was making his third takeoff on an evening training flight at Travis AFB. As the T-39 rolled down the runway, the nose wheel axle failed. The right nose wheel broke free and headed toward the grass. Just after the aircraft became airborne, the left nose wheel dropped off. Since cockpit indications were normal, the pilot was unaware of the situation. A ground observer reported the problem to the control tower operator who relayed the information to the pilot.

As the T-39 made a low pass over the field, tower operators confirmed that the wheels were missing and that the nose strut was intact. Capt Lazaro reviewed emergency procedures and computed his remaining fuel. After determining he had enough fuel to wait while the runway was foamed, he requested a three-foot wide strip of foam on the runway centerline. After foaming had been completed and the trucks were off the runway, Capt Lazaro began his approach, planning the touchdown point so that the main landing gear would straddle the foam. As the T-39 approached touchdown, Capt Lazaro held the nose off to dissipate his airspeed. He then eased the plane onto the blanket of foam and maintained positive control until it came to a stop. The only damage sustained during the emergency landing was a scraped jack pad on the bottom of the nose gear strut.

Capt Lazaro's skillful flying and procedural knowledge saved a valuable aircraft and possibly the lives of his crewmen. For this outstanding airmanship, THE MAC FLYER offers its traditional salute, "Good Show."

When Push Comes to

Well-intentioned senior officers pressure a new crew commander and affect his confidence as a decision maker.

The crew had finished clearing through the home station Operations Center. The young aircraft commander was concerned about the towering thunderstorms which threatened to interfere with this first departure of a five-day trip.

"What we might have to do," he said, turning to his copilot and navigator, "is wait until the storms pass the field. The forecaster looks for them to pass about 30 minutes after our scheduled departure time."

The hum of voices from the battle staff briefing room interrupted their conversation. The two crewmen glanced toward the door and saw the wing staff emerging from the morning briefing. Some were frowning and a large chart on the wall inside the briefing room told why. The unit's departure reliability rates had slipped badly. Two of the senior officers were still talking as they walked past the lieutenant.

"The old man said to take a look at the operation," one of the officers was saying. "We've got to get these birds off on time or all hell's going to break loose. We can't afford any more delays."

The pilot shuddered. As if we're not already getting too much help launching, he thought, making his way out the door and into the waiting crew bus.

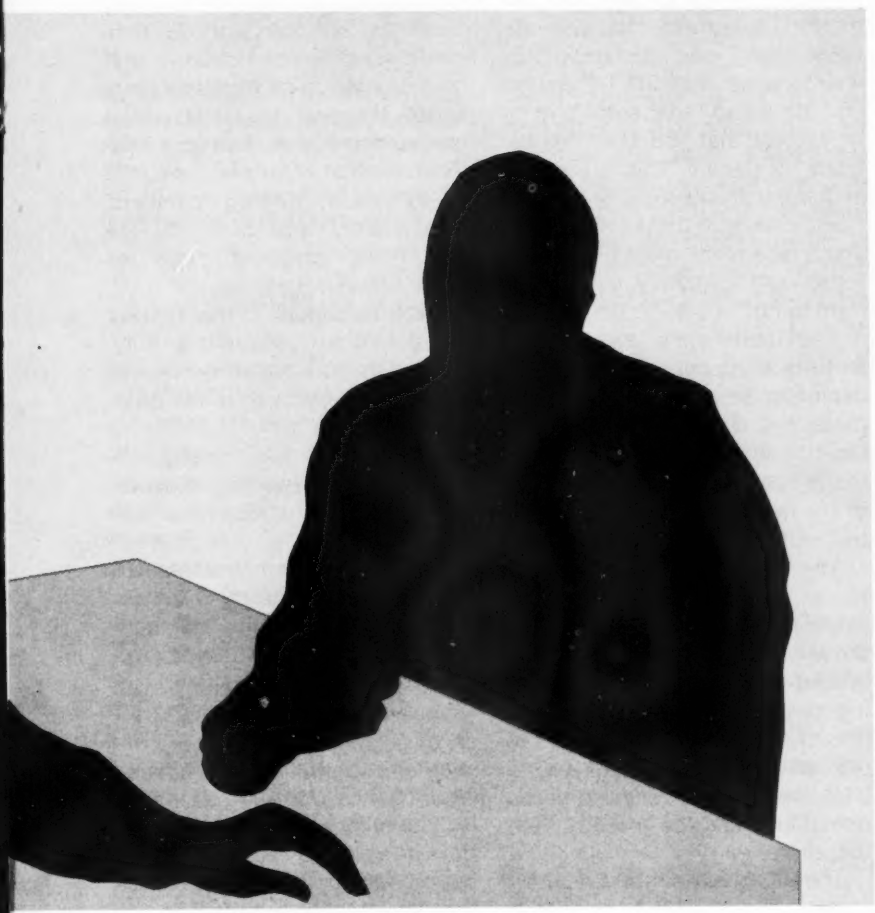
During preflight the launch control officer was right on top of the crew, coordinating with maintenance and pushing the traffic section. The SOF stood nearby with his radio, watching everything and anxious to help avoid another delay. Cripes, thought the young AC, I don't envy them their jobs, but whatever happened to the time when the AC could make his own decisions? Oh, well, I'll just do the best I can and play it safe.

Lightning flashed threateningly as the crew finished their preflight inspections. Blue-gray clouds moving toward the runway prompted the pilot to contact the Ops Center.

"We're just going to have to hold up our departure until the thunderstorm passes," he informed the duty controller. "It's too darned risky trying to go in this stuff." This time, I'm mak-

Shove

by Maj George D. Burgess
Associate Editor



ing the decision, he thought.

"Roger," the controller responded. "Stand by one."

"Lieutenant, this is Col Smith," a voice crackled back over the radio. "Now get that aircraft cranked up and in the air — fast. The forecaster says, and I agree after looking at the weather radar, that there's plenty of room to get around those bumpers. You've got radar too, so let's get with it!"

The pilot was suddenly deflated, angry, disappointed, and puzzled. It just didn't make any sense to him. First, they put me in the right seat for a few hundred hours, he thought, where I watch others make decisions. Then, there was the upgrade program, multiple training rides, a couple of check rides, and the certification board. After that they give me a crew and plane and say, "Go at it, son. The mission awaits your newly acquired expertise." And now what? The humiliation of a colonel telling me my judgment is no longer required.

The pilot bit his lip, talked it over with his copilot and navigator, and decided to give it a try. He trusted that the radar was sturdy and hoped there was no hail near the black clouds.

The Starlifter broke ground and within a few seconds was in the murky soup. The navigator, particularly adept at the radar scope, was steering the jet by most of the severe weather. Suddenly, the radar began operating intermittently. To miss all the cells was next to impossible. The aircraft finally broke out of the clouds, after a wild ride, and the aircraft commander asked his crew to check in on the interphone. There was no reported damage, but the lieutenant vowed then that he'd never let anyone — whether he was wearing eagles or one stripe — push him into a situation like that again.

Hours later, as the flight prepared for descent at its destination, the crew wrote up each maintenance discrepancy, placing particular emphasis on the radar set which was "weak and intermittent in the 100, 50, and 30 mile ranges."

The crew was alerted on schedule the following day at 0515 local. After breakfast they pro-

ceeded to the aircraft where they offloaded crew baggage from the bus. The pilot scanned the maintenance forms. Much to his surprise, the radar discrepancy was signed off, "Operational ground checks okay." Unable to understand how the weak radar could have repaired itself, the navigator gave the set a quick ops check. He found the same weak returns. They might have looked fine to maintenance personnel, but not to the crew. The signal's intermittency could not be duplicated.

Back in MAC Operations, the pilot reported his problem to the SOF. "Sir, we need the radar worked on. It's just like it was when we arrived yesterday. Too weak to trust in the forecast weather."

"What!" the SOF shot back. "Maintenance said they had your bird ready. What's the matter with the radar?"

The lieutenant explained the problem and grimaced at the SOF's response: "Sounds like that intermittent radar was one of those one-in-a-million problems that probably won't occur again. I wouldn't worry about the returns being a little weak. I can promise you these maintenance guys are really sharp and if they can't find anything wrong with it, the radar will get you to your next stop with no problems."

About that time the en route support squadron commander, pulling his daily walk-around, strode in. "What's the problem?" he asked the SOF.

The lieutenant watched the colonel's face as, once again, the problem was explained. The colonel smiled. He knew how to handle this familiar situation. He agreed with the pilot that a good radar set is required for weather avoidance. He explained that his maintenance troops were some of the finest in MAC — which they were. Then, the coup de grace: "Of course, you're the final authority," he agreed. "It's your airplane. But I can guarantee that maintenance wouldn't let you go off with a bad radar set. I strongly suggest that you take the airplane, lieutenant. This is the type of judgment situation that eventually makes or breaks an officer. You'll face many more before you retire, and I know you'll do the right thing."

The lieutenant's ears burned and his heart pounded. Dammitt, dammitt, he thought. Then he made his decision: "Thank you, sir, but after getting caught up in the bumpers yesterday because of the radar, I'd just as soon have the unit replaced."

The colonel could see his station's departure rate sinking. "Lieutenant, you're screwing up the MAC mission by sitting on the ground when you should be moving cargo. You haven't heard the last of this." He stormed out of the room, certain that the young pilot would now reconsider his ridiculous decision not to take the airplane.

The SOF turned to the crew commander. "Well?"

Forty minutes after scheduled takeoff time, the transport lifted off the runway. After leveling at altitude, the pilot commented to his navigator, "The scope looks good up here. I'm glad now we waited until maintenance replaced the RT unit."

The navigator reported his scope in fine working order also and, closely monitoring heavy returns 30 miles ahead, quickly agreed that his aircraft commander's decision had been a wise one.

* * *

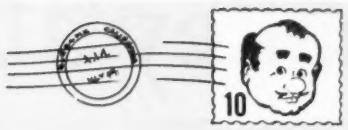
Recognize this incident and some of the characters? You may think so, but the story is ficticious. What is not fiction is that on many MAC line missions there exists the real possibility of a crew commander falling under this combination of pressures. It's up to you, as aircrew members, commanders, and SOFs, to see that these kinds of pressures never affect a decision.

Each individual in this fantasy was trying to perform his duty. And each had some degree of merit in his approach to the problem.

But for the MAC mission to run efficiently, two-way cooperation is necessary. Everyone who participates in the mission must be tuned in on the same frequency. The pilot in charge of an aircraft must respect the judgment of his supervisors, yet senior officers must have empathy with younger crew members. Experience is gained through performance and when a pilot is handed "Authority as Well as Responsibility," he must also be given a little time in which to "age." For while his proficiency is based on training, it's growth is based on experience — and not many young pilots have very much of the latter. Throughout an aircrew member's training, the underlying theme has been flight safety. And that same theme of doing it right the safe way should thread throughout his flying experience.

For when push comes to shove, that's what really counts.

A. Reader
USAF
Any place



Letters To The Editor

Ed. Note: When the 5th Weather Wing decided to select a slogan, they enlisted the aid of Major C. R. Terror to serve as a judge. The following three letters are the request for his services, his selection, and the results of the contest.

Weathermen Do It

In an attempt to stimulate interest in our monthly publication, THE WEATHERGRAM, we initiated a contest for the best "Weathermen Do It . . ." slogan. As you will note, first prize for the best slogan is a trip to Langley AFB to meet the 5th Weather Wing staff; second prize is **two** trips to Langley to meet the 5th Weather Wing staff.

We have received 136 entries so far, with only five duplications. Our problem now is to find a suitable judge — preferably an aviator of some repute who knows a little about weather and weathermen. Major C. R. Terror seems to fit our requirements admirably. In fact, most of the onlookers are still shaking their heads in disbelief at the skill and daring with which he landed the SA-16 in the officers' pool at West Palm Beach some years ago. If he's not terribly busy exacerbating his copilot's ulcer this week, we would very much appreciate a little of his time to help us in selecting the winning slogans.

Would you please ask Major Terror to choose the best three (in priority order) of the attached slogans, and return the list to us? We have also asked Fleagle the Eagle (of TAC ATTACK fame) to serve as a participating judge, and would be most pleased to have our contest judged by such a distinguished "company of eagles."

Jerry W. Roylance, Maj, USAF
Chief, Ops & Tng Branch
5th Weather Wing
Langley AFB, Virginia

5 WW/DOTO
Langley AFB VA

Greetings, m'lads,

It is with a great deal of pleasure that I submit my humble selections for your "Weathermen Do It" slogan contest.

Although requiring your, ahem, services on fewer occasions than lesser pilots, I, nevertheless, feel proud that you recognize my meteorological adroitness and that I can be of service to you.

It is not a well known fact but at one time I also established quite a reputation in the literary field and possess a very definite flair for sloganeering. But enough of that. On with my selections.

I can say most authoritatively and with all sincerity that these shibboleths chosen by me are by far the best suited for your noble purposes:

1. Weathermen Do It with Crystal Balls (well chosen words, I must say).

2. Weathermen Do It to Everybody (except for my versatility as self-made meterologist, I would be among this unfortunate number on the receiving end).

3. Weathermen Climate To Do It (Hee, hee. Clever, this play on words).

Good luck, lads, on your endeavor. And remember, if you don't like the weather forecast, just hang around until the next forecaster comes on duty.

With humble sincerity,
C. R. TERROR

Crystal Balls Win

Major Terror,

We want to thank you for your time, trouble, and cool, analytical judgment in selecting the winning "How Weathermen Do It" slogan recently. You'll be pleased to know that TAC's Fleagle the Eagle also selected "Weathermen Do It with Crystal Balls," making the choice unanimous. Under the circumstances, authors of the losing slogans were not terribly bitter. There were, however, some muttered comments about "birds of a feather . . ."

In any case, most weathermen involved would have picked no other slogan — this one is priceless. We thought you might like to have one of the first buttons with the new slogan inscribed. Since it was part of a limited issue, you will be the very first on your crew to sport one.

Again, we thank you very much for helping us out. We enjoyed your letter as much as we enjoy your adventures every month in THE MAC FLYER. Please keep writing.

Sincerely,
George M. Horn, CMSgt, USAF
Senior Airman Advisor, 5 WW

Shakey's Alive and

Shortly after this article was prepared for publication, Old Shakey developed structural problems and the National Guard units are being equipped with C-130s. Ed.

Let's call this a survival guide. It's written especially for all you poor souls who have to take care of transient aircraft and especially for those who get nervous at the thought of a C-124 appearing on the horizon. I've seen the expressions of panic on some young faces when one of these old birds squats down on the runway. I'm here to tell you it ain't that bad.

Still, I can understand your feelings. Heck, the Ancient Aluminum Overcast was built before some of you kids were born. It has propellers, pistons in its engines, tubes in its electronics, and more creaks and groans than a woolly booger with the gout.

But before you turn up your nose: It will also airlift more cubic feet of stuff off a 3,900-foot gravel strip, uphill and downwind, than three of anything you got in your jet-type Air Force. So just cool the cat calls.

What are your chances of spotting one of these 1950 wonders? Well, not quite as good as seeing a whooping crane. There are about 59 whoopers now and fewer than 30 Shakeys. Most of the surviving members of this endangered species belong to the Air National Guard Groups at Oklahoma City, Okla.; Memphis, Tenn.; and Savannah, Ga. By the way, they just got an Air Force Outstanding Unit award for delivering all kinds of big boxes past the Arctic Circle in their obsolete aircraft.

What can you expect if Shakey comes to call? First of all, we already know that you won't have any spare parts and you won't have any mechanics qualified to work on any part of the bird, so don't be embarrassed. You will be relieved to know that we carry a pretty good assortment of parts with us, and it's perfectly normal for us to have a mechanic or two on each flight.

We also expect to be parked out in the north 40 because you probably won't have a tow bar or anyone to taxi the bird if you have to move her.

Now, we are talking about an airframe which averages 20,000 hours (that's about 4½ million miles) and we just don't worry about things breaking. They do

Flying in the ANG

A handful of ANG units may fly your way in the remaining C-124s, and if you're not used to Shakey—don't panic.

by Lt Col Gene Allen
137 MAW (ANG)
Okla. City, Okla.

and we fix 'em. We do appreciate any help you can give with work stands, lights, and things like that. We also welcome sidewalk superintendents. Heck, you can even charge admission if you want. Watching one of our mechanics change a cylinder is in the same category as seeing a diver give mouth-to-mouth resuscitation to a beached whale. Good for the younger fellows to see how easy they got it nowadays.

If you have any cargo for us it may take a little longer to load since we can't use any of your fancy pallet loaders, but we'll try to make up for that by taking any unusual stuff you have — like that seven-sided widget that won't go through anybody else's cargo doors. One of you came up with a couple of live cows a while back. We don't mind. We're glad to get the cargo.

We realize that fuel can be a problem. Since we use 115/145 AvGas, and lots of it, we may stretch your supply. We'll do our best to conserve what you have. We've even found oil in short supply lately. You probably don't have anything on base that takes 320 gallons just for openers. Since engines our age do use a bit of oil, we've taken to carrying some cans along. We'd rather not use it because it's a pain to crawl out on the wing and dump in five gallons at a time; but if it's necessary, we will.

For you operations types, don't be surprised when we ask for low level flight plans, even for over water flights. No pressurization, you know. We'll try to repay your extra trouble by helping out with reports on 8,000-foot winds, sea conditions, or even search and rescue. After all, we have lots of time en route and there just ain't much traffic where we fly.

You'll find our crews are kind, trustworthy, and patient with your problems. We've been cruising low and slow for a long time. We have lots of 10,000-hour crew members, and we believe in the MAC mission and creed. We may look a little goaty after a 14-hour leg, but we'll put our high frequency hearing up against that of your young jet jockeys any time. Old Shakey may rumble a lot, but she sure don't whine much.

One more thing. It sometimes happens that one of these old birds breaks so bad that we just have to walk off and leave it. Being weekend warriors, we can't always wait. But don't worry. We'll be right back to pick it up. We wouldn't dream of littering your flight line, and, besides, every one of these faithful flying machines is a genuine Early American collector's item.

One of these days, would you believe, we're gonna sell 'em and get rich.

ABOUT THE AUTHOR

Lt Col Allen is the Information Officer for the 137 MAW (ANG), Okla., Air National Guard, Will Rogers World Airport, Okla. City and former commander of the 137 AAS. He was last year's winner in the flying safety writing contest with his story, "The Model Man." Col Allen has over 1,000 hours flying time in the C-124 as a non-rated aircrew member.

A physician explains fatigue and how it affects a crew member's flying skills.

Aircrew Fatigue = Skill D

Ed. Note: Col Kenneth W. Curtis, Jr., while Deputy Commander for Aeromedical Services, 375th AAW, contributed this informative article on aircrew fatigue. The second story, reprinted in part from DC FLIGHT APPROACH, McDonnell Douglas Corporation, discusses the effects of relative humidity on aircrews and explains how airborne exercise can help stave off these effects.

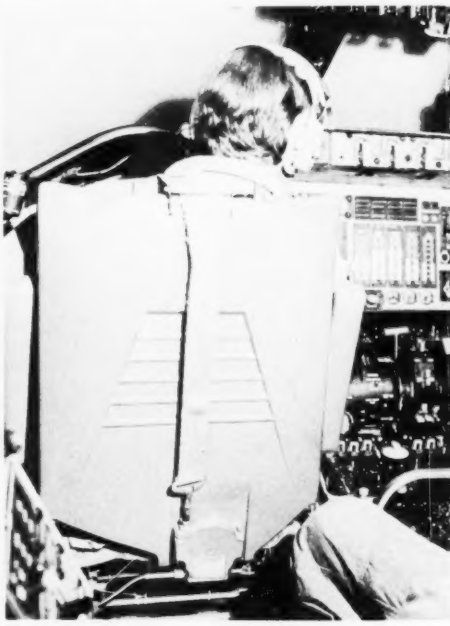
Crew members in the 375th Aeromedical Airlift Wing at Scott AFB, Ill., were recently asked, "What is most likely to cause or contribute to the next aircraft accident?" Fatigue ranked high on the list. The wide variety of comments relating to fatigue indicated some basic misunderstandings; a discussion on the topic is appropriate. There are various types of fatigue — muscular fatigue and most importantly for the crew member, skill fatigue. Let's take a brief look at both of them.

Types

Muscular Fatigue: Fatigue is not a precise scientific term and is difficult to define scientifically or to measure. Most scientists examine a particular result of fatigue. The number of muscular contractions before a muscle becomes tired can be measured. So can the buildup of organic waste products during exercise or the subjective sense of fatigue. As crew members, we are not often bothered by muscular fatigue associated with heavy physical effort — apologies to you loadmasters.

Skill Fatigue: A more significant consideration for intrepid aviators is skill fatigue or the deterioration in performance caused by work that demands persistent concentration and a high degree of skill. It is an insidious phenomenon associated with failure of memory, judgment integrating ability, and presence of mind. Skill fatigue was, perhaps, best described in a series of findings commonly known as the Cambridge Cockpit Studies.

A Spitfire cockpit simulator was used, and 140 subjects, mainly student pilots, flew sessions of two to seven hours. In two hours, precision of air speed and sideslip control decreased 50 percent. The timing of procedures decreased steadily during the experiment. Thus, the pilot would do the right maneuver, but at the wrong time. Fatigued subjects accepted lower standards of accuracy and performance. Fresh pilots used all the instruments together; however, with fatigue, this integration failed, and they would "chase" one instrument at a time. Their memory also decreased, and towards the end of the session, they would forget to monitor side instruments. Eighty of the 140 forgot to lower the gear for at least one landing!



An observer can easily see th

Of paramount importance to all MAC crew members is the "end deterioration" phenomenon. When the pilots in the test were told they were approaching the end of the experiment, they experienced an irresistible tendency to relax. This, of course, makes that last landing of the day potentially very dangerous. The experiments were repeated with more experienced pilots. These pilots went through the same sequence of skill deterioration; however, the onset of skill deter-

by Dr. (Col) Kenneth W. Curtis, Jr.
375 AAW, Scott AFB, Ill.

Deterioration

ee the tired crew making mistakes.

ioration was delayed, indicating that training, and even overtraining, helped ward off the effects of skill deterioration.

Now that we have a handle on the basic types of fatigue, let's take a look at some of the factors that contribute to fatigue: sleep habits, smoking, alcohol, drugs, eating habits, and physical fitness.

What Causes Fatigue

Sleep: Accident boards look at the pilot's activities for the 72 hours prior to an incident to evaluate fatigue. Pilots, like athletes, frequently are unable to sleep well the night prior to a flight; however, good sleep two nights before a mission is equally, or more, important. If you "toss and turn" all night before a flight, don't worry too much. Although you won't feel as refreshed, studies indicate that just lying down provides more than 80 percent of the value of sleep!

Smoking, Alcohol, and Drugs: Many factors, other than activity or work, contribute to fatigue. Smoking 20 to 30 cigarettes a day gives a blood carbon monoxide level of about five percent. Your tissues receive the amount of oxygen they would if you were breathing air at 7,000 feet. If you add a cabin altitude of 8,000 feet, your resultant physiologic altitude will be 11,000 to 12,000 feet. That is fatiguing! Three cigarettes in 30 minutes will raise your eyeballs to 8,000 feet as far as night and peripheral vision are concerned. That is before you leave the ground. Alcohol inebriates certain oxygen transport enzymes on the cell membranes and contributes to that tired feeling the next day. Not only does alcohol add to fatigue by interfering with oxygen uptake by the cells, it depresses the brain cells and impairs coordination, sensory acuity, memory, and judgment, the same functions that suffer in skill fatigue.

There are many drugs that interfere with the oxygen delivery system. Chloromycetin, an antibiotic, may depress the bone marrow that produces blood cells and cause an anemia. Sulfa, acetanilid, and phenacetin (in ACPs) may change the hemoglobin so that it no longer carries oxygen. Any depressant drug or pain killer that contains an opium derivative depresses respiration. There are a few drugs that increase tolerance to hypoxia, but except for glucose, they have too many side effects to use while flying. The only safe position is to avoid all drugs while flying.

A general rule to remember is that anything that interferes with oxygen delivery to the tissue cells contributes to fatigue and anything that enhances oxygen delivery combats fatigue.

Eating and Exercise Habits: Low blood sugar and lack of oxygen (as at altitude) both cause a measurable decrease in skilled performance. Interestingly, oxygen partially counteracts the effects caused by a low blood sugar, and sugar will combat some of the effects caused by low oxygen. Thus, it is wise to eat regularly, but lightly, while flying. Too much food, such as a heavy, fatty meal, will increase the blood flow to the gut at the expense of the body. The consistency of the plasma is also changed. These factors, in part, account for drowsiness after a large meal.

Lastly, poor physical conditioning leads to changes in the heart, lungs, blood, and arteries and impairs the body's ability to process oxygen. An aerobically fit person, compared to a person not fit, will have a 50 to 100 percent time delay in the onset of fatigue. So, to delay fatigue on those long MAC missions, exercise regularly between flights.

In summary, approach flying as you would train for the Olympics. You will still become tired, but, with moderation and discretion in your activities, you will still have a wide margin of safety.

The Fatiguing Effects of Humidity

At flight altitudes, with the cabin pressurized at 8,000 feet (8.7 pounds per square inch), the cabin relative humidity is approximately one-third of one percent and the outside maximum absolute humidity of the atmosphere is only a fraction of this. This low ambient humidity can affect the well-being of the crew because of the insensible water loss to the ambient environment. If this water loss is not replaced, the respiratory tract (nose, throat, lungs) and the eyeballs suffer significant water loss. To relieve the dryness of the eyeballs, the blinking process sponges the eyeballs with moisture contained within the mucous membranes which line the inner surfaces of the eyelids. Normally, blinking requires one-fifth of a second; however, due to dryness and irritation, the time is increased and affects eye movements which, in turn, affect visual performance. General feelings of weariness of body and mind from strain or oppressive climate, and bodily weakness or discomfort can develop, affecting task performance and accelerating fatigue.

Most crews are aware that moving about or performing calisthenics after a lengthy sitting period will help relieve fatigue. Under flight conditions, vigorous exercise programs are out of the question; however, there are certain limited exercises that can be performed by a pilot, copilot, or flight engineer while remaining in his respective seat. During the last hour or two of a medium or long-range (intercontinental) flight, the aircrew will find it beneficial to perform calisthenics similar to the following:

★ Rotate body in both directions (stop-to-stop) with arms folded across chest.

★ Arch back while stretching arms upward. Reverse arch and hump forward as much as possible. Briefly contract back and torso muscles vigorously in each position. Move head and neck through full range of motion.

★ Extend both arms level from shoulder to either side, briefly contracting the extensor and flexor muscles vigorously. Move arms to forward position and rotate from the shoulders repeatedly, using strong muscle contractions. Then rotate arms from elbows in the same manner through full range of motion.

★ Extend the knee, if cockpit area permits, so that entire leg is straight, contracting thigh muscles. If not possible, contract the same muscles as in the extending of the leg. This action requires counteraction by opposing muscles (flexors of thigh) so that all thigh muscles are in action at the same time.

★ Move toes up and down, then side to side, then rotate in both directions.

In all the preceding exercises, it is not necessary to hold the muscle contractions for more than three seconds. If there is a tendency toward muscle cramps, the contractions should not be maximal nor held as long, but may be repeated.

All exercises of this type promote good blood circulation by removing waste products which induce fatigue, and by bringing in fresh supplies of oxygen and nutrients.

Repeated long flights without the replacement of insensible water loss could cause temporary dehydration and increased viscosity of the blood, which in turn could result in heart-lung symptoms.

Insensible water loss by evaporation of water through the skin and through respiration will be approximately 40 percent greater at flight altitudes than it will be at sea level. The longer the flight, the more serious the water loss could become.

This biomedical problem can be minimized if the crew will constantly replace the water loss not perceptible to the senses. It has been estimated that approximately two ounces of water are required (in addition to normal fluid intake) for each hour of flight. This fluid intake should be drinking water, not coffee or tea.

Contrary to popular belief, continuous coffee drinking does not always promote alertness, but frequently causes fatigue because of the excessive intake of caffeine. This buildup of caffeine in the blood can also cause disturbance in the rhythm of the heart beat, which is often associated with fatigue. A healthful practice, therefore, would be to space each cup of coffee two to three hours apart. The fluid intake schedule proposed, when followed, should prevent crew dehydration fatigue at high altitudes and low humidity.

Global Notes

award winners

MAC Distinguished Individual Safety Awards were earned by the following MAC men for dedication and professionalism in the performance of their duties:

Maj Bluford B. Fleek, Det 5, 39 ARRW, Tyndall AFB, Fla., ("Good Show," July issue), was on a drone recovery mission when his H-3 helicopter experienced a rapid loss of transmission oil pressure. This condition might have resulted in an in-flight fire or transmission failure. However, Maj Fleek initiated an emergency descent and landed safely with no injuries to the crew and no damage to the aircraft.

Capt James S. Thomas, a controller at the McClellan AFB, Calif., Operations Center, was instrumental in providing technical assistance to two distressed WB-57 aircraft after receiving notification of simultaneous emergencies on both aircraft. Activating Operation Skyhook communication procedures, Capt Thomas connected aircrew standardization and technical experts on open communication lines to the stricken crews. Due to further aircraft problems and the lack of suitable recovery points, Capt Thomas maintained continuous open communications and transmitted coordinated information from concerned agencies. His actions contributed to the safe recovery of both aircraft.

Capt Alan C. Murphy, 48 ARRS, Fairchild AFB, Wash., was aircraft commander of a UH-1N helicopter supporting the USAF Survival School. While taking off from a rugged, densely wooded training area, his aircraft experienced a rapid series of severe compressor stalls. With severe power loss at low altitude and low airspeed, Capt Murphy, nevertheless, executed a landing in an adjacent clearing just large enough for the helicopter. The helicopter received minor damage.

First Lieutenants Richard L. Greenlee and **LeAllan L. Burough,** Det 5, 37 ARRS, Malmstrom AFB, Mont., were transporting eight passengers in their UH-1F Huey when a fuel control failure caused their aircraft engine to decelerate to flight idle. Hampered by a direct crosswind, the crew skillfully executed a hovering autorotation which terminated with no injuries to the passengers or damage to the aircraft. Six of their passengers were distinguished visitors.

A possible T-39 accident was averted at Travis AFB, Calif., ("Good Show," Capt Lazaro, this issue) through the skillful observations made by **TSgt Jon D. Durbin,** an expediter with the 60th OMS, Travis AFB. Sergeant Durbin spotted the nose tire falling off the stricken Sabreliner and reported it to Job Control for relay to the Operations Center and the pilot. The NCO exemplifies the slogan in MAC that "Everyone is a safety officer."

COMAC presents chief of staff award

SSgt William E. Roberts of Det 1, 2d Weather Wing (MAC), Lindsey AF Station, Germany, has been awarded the Chief of Staff Individual Safety Award for 1973.

General Paul K. Carlton, Commander MAC, representing the Air Force Chief of Staff, presented the award to SSgt Roberts in ceremonies at Scott AFB, Ill.

This prestigious award is presented annually to no more than four Air Force members or civilian employees who have made the greatest contributions to safety in the Air Force.

Sgt Roberts, whose parent unit, the 2d Weather Wing, is located at Ramstein AB, Germany, was recognized for initiating a variety of effective management methods in the wing's accident prevention program.

During 1973, Headquarters MAC awarded Sgt Roberts a MAC Outstanding Individual Safety Award for his organization's excellent safety program. He also was selected as the MAC Safety NCO of the Year.

Signature in the Sky

Invisible and deadly, wake turbulence may catch you unaware unless you pay attention to other aircraft.

by Capt A. R. Barbin, Jr.
Associate Editor

Subtle and usually invisible, it often catches its victims by surprise. Although a relatively new hazard, it is one of the deadliest of modern aviation. It is wake turbulence.

The fact that pilots are unable to see it coming accentuates the danger of this aeronautical hazard. Unlike thunderstorms, wake, or vortex, turbulence provides no visible indicator preceding its arrival. Miss one radio call announcing its presence, and you could be in the most serious kind of trouble.

Since 1965, eleven USAF accidents have been attributed to wake turbulence. Its victims include a near cross section of the Air Force inventory, airliners, and general aviation aircraft. But larger aircraft, which we think of primarily as turbulence generators, are also vulnerable to vortex turbulence.

A few years back, a C-141 landed hard during a CAM formation landing. Just prior to landing, the number two aircraft entered the wingtip vortices of the lead aircraft. The left wing dropped suddenly and struck the runway. The pilot of the Starlifter managed a successful go around and subsequent recovery. He was fortunate, but you may not be.

Just over two years ago, a commercial DC-9, flying less than a minute behind a DC-10 on final approach, entered the left wingtip vortex of the larger jet. The DC-9 flipped rapidly to the right, continued rolling to a near inverted attitude, and crashed on the runway. Two military jet trainers on final flew into the trailing vortices of a Boeing 707 and a four-engine turboprop in two separate accidents. Both aircraft went out of control and crashed, killing four fliers.

History

The Federal Aviation Agency first became involved in the wake turbulence problem during the early 1950s. With the advent of heavyweight, wide body jumbo jets in the early 1970s, the FAA initiated a series of urgent flight test projects to investigate the phenomenon and document the findings. The test program was later expanded to include conventional jet transports and corporate jets. Results of these flight research projects provided valuable information on the characteristics of wake turbulence and vortex strength and were key factors in the design and application of current air traffic control spacing procedures.

Vortex Generation

Each aircraft in flight, from the smallest homemade racer to MAC's own C-5A, trails its own signature in the sky. For the former, a barely discernible etching — for the latter, a broad brush stroke. These signatures consist of two counterrotating, cylindrical air masses trailing aft from the wingtip, and are known as trailing vortices.

Occasionally, wing vortices are visible behind large jet transports during departures and high powered approaches when contrails and visible jet engine exhaust are swirled up and around the wingtip.

Vortex characteristics vary in degree and severity from one aircraft category to another and can be compared to wakes produced by a canoe versus an aircraft carrier. The heavyweights really stir up the pot.

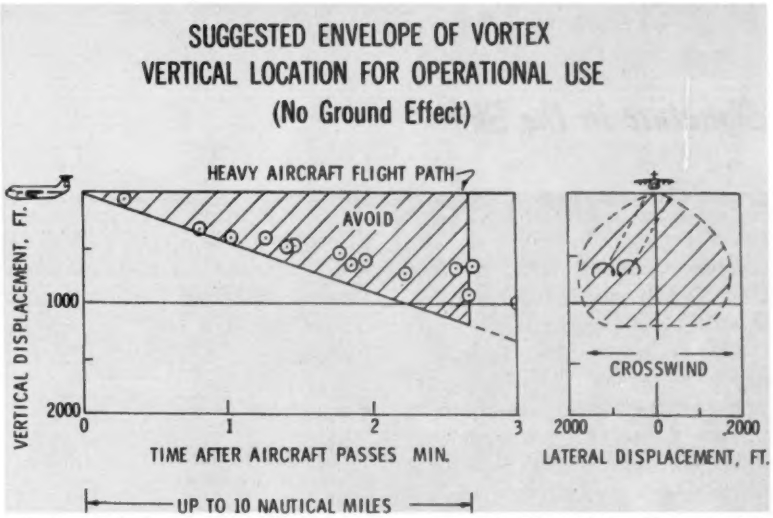
Vortex Characteristics

The strength of an aircraft vortex is governed primarily by the

weight, speed, and shape of the wing of the generating aircraft. Of these variables, the dominant parameter is aircraft weight. Vortex strength increases proportionally to aircraft weight. The greatest strength occurs when the aircraft is heavy — clean — and slow. For example, a loaded C-5A will generate the most severe vortices after flap retraction during climbout and prior to flap extension at an airspeed at or below 185 knots. Lift augmentation devices, like flaps and slats, reduce vortex rotational velocities somewhat, but not much.

In one recent test, airflow sensors, spaced at one-foot intervals on a 142-foot tower, detected peak vortex tangential velocities of 187 feet per second (128 m.p.h.) generated by a configured DC-10 — sort of like mini-tornadoes off each wingtip. Evidence developed by FAA indicates that vortices tend to remain in trail behind the aircraft. They descend at a rate of 400 to 500 feet per minute to an altitude of 700 to 900 feet below the producing aircraft. Here they remain and slowly dissipate. The area of the most likely encounter is directly behind and slightly below the preceding aircraft.

Lingering vortices can be a real headache in an area of high density operations. Dissipation of vortex turbulence may take up to two minutes, or more, in free, stable air with little or no crosswind. In another FAA vortex flight test, vortices were tracked on a Boeing 747 for 142 seconds and remained essentially in the same position over the ground, plus or minus 50 feet, in a five-knot crosswind. Discounting the effects of crosswind components, there is virtually no lateral displacement of vortices directly behind an aircraft out of ground effect.



In a no-wind condition, when the twin vortices sink into ground effect, they tend to separate and move laterally at about five knots, stabilizing at 50 to 150 feet above the ground. But a light crosswind moves the vortices and may position a vortex over the approach end of the runway directly within the approach flight path of succeeding aircraft. Once the aircraft weight is on the runway, the twin vortices terminate. When the aircraft wings assume the weight burden at the rotate point on takeoff, calm air is again stirred up into a cyclonic frenzy.

Aircraft Behavior

Aside from a bone jarring ride, the greatest hazard associated with flight into wake turbulence is loss of aircraft control due to the extreme roll rates. NASA and FAA flight tests with C-5 and Boeing 747 jumbos revealed some startling data. The captain of an FAA Convair 990 had to use 40 degrees of the available 70 degrees of wheel deflection to maintain control three miles behind a clean configured C-5 cruising at 170 knots. At three to eight miles behind a Boeing 747, the Convair required full wheel deflection. The difference between the Convair wheel deflections behind the two jumbo jets is due, in part, to the difference in wing sweep of the C-5 and 747. (C-5, 25 degrees; Boeing 747, 37.5 degrees.) Vortex intensity amplifies with wing sweep.

In the small airplane department, a Lear Jet rolled nearly 120 degrees in one and a half seconds while flying 3.7 miles behind a C-5, and a light twin-engine plane rolled out of the vortex even though the pilot used full wheel deflection. Penetrations of C-5 wake turbulence by fighter aircraft produced roll rates of up to 170 degrees per second.

Because of the limited width of a vortex, initial vortex penetration may affect only one wing and will

thus induce a rolling moment to the affected aircraft. A pilot's instinctive reaction is to counter the roll with opposite aileron. As the affected wing passes through the vortex center, the rolling moment decreases, reverses direction, and then increases again as the other wing enters the cyclonic trail. The applied aileron is now in the same direction as the reversed roll and will accelerate the rolling moment in the new direction before the pilot is able to apply corrective action. As the aircraft progresses well into the vortex, the other wing is now being affected by the vortex, further accelerating the roll rate. Even if full aileron is correctly applied to counter the new roll, it may be insufficient to stop the roll if the aircraft's normal aileron response is less than optimum. Aileron ineffectiveness will be more severe if the entire wing span is engulfed within a single vortex. As a general rule, smaller wingspan aircraft are more subject to uncontrollable roll rates in a vortex than those of a longer wingspan.

Precautions

The most important pilot technique in connection with wake turbulence is to avoid it. But vortex avoidance requires knowing where it's likely to occur. And, if all else fails, you'll need to know how to get out of it.

If you're flying something less than a heavyweight (300,000 pounds or greater), the minimum distance between your flying machine and a jumbo should be ten miles or four minutes. Aircraft considered "jumbos" are the C-5, B-747, DC-10, L-1011, B-707-320 and 420, DC-8-50 through 80 series, DC-8 series 61, 62, 63, C-135 Electronics, VC-137 VIP, Russian IL-62, BAC VC-10, B-52, and even the C-141. Takeoff behind one of these aircraft should be delayed for a minimum of four minutes to allow time for the generated vortices to dissipate. If heavy jets are operating from parallel or intersecting runways, the takeoff time interval on another crossing or parallel runway can be reduced to three minutes.

The minimum distance and time interval between two heavy jets is five miles or two minutes. But remember, this is a minimum interval and flying that close behind a heavy is likely to be turbulent and unnecessarily uncomfortable for airplane and contents.

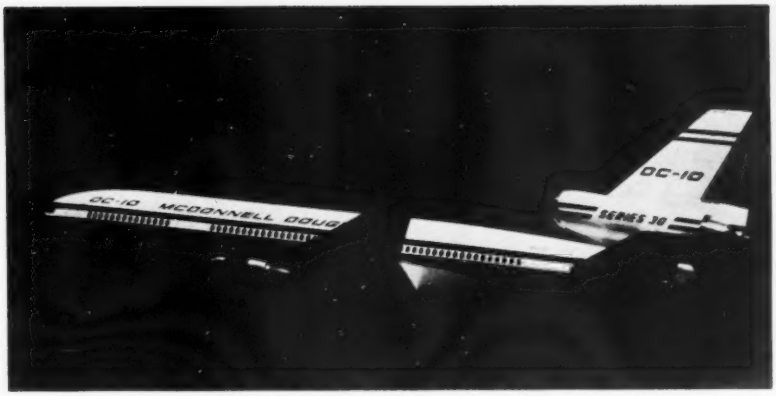
At airports handling high volume air traffic, aircraft of nearly every category are rapidly sequenced, often at minimum distance or time intervals during departure and arrival operations. Number two on final approach behind a jumbo can be tricky, particularly if the jumbo is flying a precision approach and you're flying a nonprecision or visual approach. Since the most likely vortex encounter is below and directly behind the flight path of the generating aircraft, a descent to nonprecision MDA will normally place the following aircraft below the precision glide path — right in the jumbo's wake! Under

The area to avoid behind the big birds.

certain conditions of wind and time interval (light crosswind and within approximately two minutes) behind a heavy aircraft, entry into vortex turbulence is certain. Runway length permitting and you're number two to land behind this jumbo, consider a flight path slightly higher than the machine ahead of you and land a little long, runway length permitting (2,000-3,000 feet from the threshold). This technique will minimize the possibility of getting jostled about in lingering vortex turbulence in the vicinity of the runway threshold.

If vortex turbulence is encountered, initiate a quick exit by flying upwind, climbing and, if necessary, executing a missed approach. Don't attempt to hang in there trying to salvage a shaky approach. Vortex strength may exceed the capacity of your flight controls to offset rapid roll rates. There may be too little altitude and too few knots, above stall, to recover.

During close takeoff intervals behind a heavyweight, fly high and turn upwind once the gear is in the well. Initial climbout at an airspeed between 105 and 130 percent of stall speed is no place to get sucked into the cyclonic tentacles of a Brutus Heavius. One way to stay above vortex turbulence during takeoff and initial climbout is to slip the surly bonds a little sooner, if possible, than a jumbo. If a jumbo's ground roll distance is 7,000 feet and that of the following aircraft is 4,000 feet, then the flight path of the following should be a few hundred feet higher than the jumbo — and its vortex turbulence. But if the number two aircraft's takeoff distance is equal to or greater than the jumbo's, then initial climbout will be behind and below the larger aircraft — right in the core of the jumbo's twin vortices — no fun at all!



Give wide berth to the big aircraft.

Because of the variance of aircraft size, weight, speed, and configuration, it's impossible to establish foolproof procedures and techniques for every possible vortex confrontation. But the tips on pilot techniques and vortex avoidance in this article should help you stay clear of the vortex menace and, hopefully, give those who get caught a way out.

REFERENCES

NASA Aircraft Trailing Vortex Research by William A. McGowan, NASA Headquarters, Washington, D.C.

Aircraft Wake Turbulence by James F. Rudolph, Director, Flight Standards Service, Federal Aviation Administration

Wake Turbulence, FLIGHT SAFETY REVIEW, Royal Air Force

The TDY Supervisor of Flying experiences unexpected problems as he plays tour guide to local senoritas.

C.R. TERROR

Buenas Dias, mi senoritas Espana."

The Continent's Lothario of Languages and Ladies greeted two female friends whom he had met while sipping sangria the night before. C. R. felt suave and confident with the Mexican Spanish he'd learned years ago in Matamoros.

"Slide into el automobile and your toastmaster and tour guide will ride you around the ramp. We'll visit the C-5, and the C-141 Starlifter, the world's most reliable aircraft — tamed by me in the 60s."

The girls giggled at the paunchy linguist, not fully understanding his peculiar dialect nor the significance of their unauthorized entry into the flightline restricted area.

"Been TDY here a week for this big exercise. Practically in charge. Because of my vast reservoir of flying experience, they pulled me away from my headquarters job to jet over here and augment the Supervisor of Flying troops." An air of importance emitted from the rounded man in flight suit. "Shall we go?"

"Gracias, senor," responded one of his companions. The trio settled into the seats of the staff car marked, "Supervisor of Flying."

"Won't bother signing out; time's too important. Besides, my pen is el broko — reminds me, I must have a crew pick one up for me their next time into TUSLOG. Here we goo —"

The blue staff car jerked as poor clutch technique foiled a smooth drive-away. The Undaunted Driver fingered the amber rotating light switch and sensed the awe come over his two passengers as they watched the light's reflection in the windows of the ops building. Urged on by this minor triumph, C. R. turned on the UHF radio.

"Listen, girls. You can hear the fighter jocks chatter on guard frequency. Very exciting at times." He watched their amazement with glee as the car speaker crackled after each transmission.

"Must keep in touch with the combat crews in the air. Never know when my expertise will be needed to solve an emergency problem.

"Over here in front of the C-5 we have the four-sixty-three-el loading dock . . . the visor lifts to allow loading through the nose . . . thirty-five arrivals and departures per . . . the SOF supervises all of this to keep the operation safe and —"

"Senor major, are you boss of all theese people?" asked one of the girls.

"Yes, well, you see when I'm on duty I must supervise all operations out here. For instance I try to — hey, just a minute! That airman over there is not supposed to work on that engine without reference to his tech data. Must stop and make an on-the-spot correction for this gross negligence. Excuse me, ladies." This was his chance to really impress his local visitors.

His Spanish companions watched as the Paunchy Pilot waddled over to a mechanic who was working on a C-5. Airman Smith stared in disbelief as the major, scolded him.

". . . and you're lucky that I'm not in a mood to take names. Better shape up, m' lad." Before the airman could respond to the verbal whiplashing, the bandy legged lecturer wheeled and spun off.

"Nothing to it. A tiring job trying to keep your people in line. Gotta keep on them, though, or they'll mess up your ORI. Shall we look at a Starlifter now?"

"Si, senor," answered the puzzled girls as C. R. motioned toward a vacant C-141.

"Hold onto the rail as you go up to the cockpit. I'll follow close behind you. Don't be frightened," urged the Paunchus Pointer. "That's it, take your time —"

"Si, theese es high place," cried the first girl in the cockpit.

"Ah, yes," gasped the Opponent of Aerobics, crawling into the cockpit. Following a breath-catching pause, he continued, "Tis one of the finest aerospace — ah, whew, — vehicles around. Have a seat in the chairs up front, my chickadees. You'll find them as comfortable as the booths at your club — and a bit less expensive, I might add — heh, heh."

The two visitors took their places in the pilot's and copilot's seats.

"What you see here is the wheel house. From here I direct the crew members and control the mechanical systems which give life to the machine. The crew communicates through these telefono lines. Lets me keep tabs on them."

The girls seemed unimpressed at the explanation. To quell their ho-hum attitudes, C. R. swung from the jump seat, pushed aside a warning placard, and flipped on the battery switch. Holding the caution light switches to test, he lit up dozens of annunciator lights, flooding the flight deck with the amber, red and green colors like a Christmas tree.

"Ah, senor — muy bien."

Success at last, thought the host. Still, there must be something else, something big, which would obtain a hand clapping response from his two lovelies. Ah, yes, that's it —

"Let me demonstrate how I handle an inflight emergency, m' dears. Now, follow along on a flight with me as I explain the skill required to command an aerospace vehicle like this. Picture that we're cruising at flight level 350 — that's seven miles high. All's normal. The copilot is resting in the crew bunk and the pilot is up front watching over the interworkings of the aircraft." C. R. shook the yoke to simulate that he had physical control of the Starlifter.

"All of a sudden, without warning — bam! We hear an explosion," cried the excited story teller. "We look up to see the number four engine losing power and its fire warning light on steady. Gotta do something fast! So, I reach up and calmly pull the fire control handle, cutting fluids to the flames licking at the engine pylon." A pudgy limb pulled out the T-handle. "But, the fire continues. The next step comes second nature to me. I reach up here and fire the bottle to —"

The cockpit lights flickered as the fire bottle responded to the command and discharged its agent into the engine.

"Whoops. Heh, heh. Well ladies that about covers it," blurted the excited SOF. "You get the idea. Commanding a large aircraft has many responsibilities and requires many a quick reaction. Well, let's head over to the Steak House for a charburger and cola. Don't want to wear you out."

The exit from the Starlifter resembled an emergency egress as the shattered leader quickly ushered his girl friends out of the plane. No reason to tell maintenance that a fire bottle's been fired, he thought. They'll catch it when they do their preflight, anyway.

The tenor voice started again as the car moved down the flightline. Distracted by his own chatter, the host failed to see a formation of onrushing fire engines, with lights flashing and sirens blowing, responding to a call. The SOF casually drove into the path of the vehicles. Oblivious to the danger, he smiled and rambled on with his oratory.

C.R. TERROR

"The mission here is so time consuming that it militates against spending more time at your club. However, I certainly want to buy you gals a toddy tonig —"

Skillful driving by a fireman barely averted a collision between the huge red truck and the blue car. The Master of Wires and Tires swiveled his shiny dome like a turned on gyro.

"That coot! That Jackal! blustered the flustered SOF. "What's he trying to do, kill us? Why if I hadn't recognized danger in time, we might have had a report to fill out. Must make a note of this incident in my log. Hope you're not shaken up, my sweets."

The two riders spoke to each other in Castillian Spanish — quite impossible for the flushed major to understand. ". . . this little creature must be watched. Who knows what is next?"

Recovering from the minor setback, C. R. continued his monologue en route to the Steak House.

"Here we are, m' dears. Let's enjoy a sandwich and drink, after which you can return to your apartments to rest for tonight's performance. I'll be in the front row for the late show."

"Major Terror!" An NCO with a MAC patch on his utility uniform startled the suave SOF. "The Operations Center has been looking all over for you. We've had an emergency on the flightline. A C-141 had a fire and they tried to get you, but I guess your radio wasn't working on our frequency."

"Harrumph. Can't be too serious. Why I've been attending other important duties. One guy can't be every place at once, my man. Thank you, though; I'll return to MAC Ops as soon as I bid farewell to my two official guests."

"Being an en route squadron commander is challenging enough without any SOF playing tour guide in a restricted area. Major, has it dawned upon you that you caused a serious fire on a C-141 out on the ramp? Had you been a little more interested in your work, you'd have seen that the bird's Form 781 had an entry warning not to apply electrical power because of bare wires in the fire extinguishing system. When you disregarded the warning placard and turned on the battery switch and fired the bottle, the wires started smoldering and caused the fire. Some job of supervising, Major!

"Luckily, Airman Smith was returning to his maintenance shop, spotted the fire, and called the fire trucks. They were responding to the fire when you tried to cut them off. By the way, can you tell me where you got authorization to escort uncleared civilians into the restricted area?"

C. R. hesitated for a moment, the invisible wheels in his cranium starting to turn.

"Well, bein' the Supervisor of Flyin' and in charge of the ramp, I thought I'd establish rapport and make a good impression to a selected sampling of Spanish senoritas. I'll be TDY here for awhile, and you know how important good relations are with the locals these days, especially in a foreign land," emphasized the Bald Bon Vivant.

"Major Terror, I have only one word to say and it's adios. Pack your bags and report to the passenger terminal in one hour. You're going to be a passenger on the first westbound C-141 before the day is out," barked the irate commander.

"B-b-but sir, I am expected to attend a series of social engagements and festivities this evening," pleaded El Supremo.

"You only have 58 minutes," interjected the unsympathetic boss.

A short while later C. R. stumbled into the passenger terminal dragging his usual assortment of custom hand tooled baggage, golf clubs, and spiritus fermenti incognito. Gazing at the passenger manifest, a devilish smile replaced his frown. Near the top of the manifest, the Lothario of Levers spotted a familiar name— Capt Charlene Charming.

"Why, hello Major Terror," soothed the attractive nurse. "It's sure a small world. Are you going back to the states on this flight?" asked the beautiful blond.

"Yep, just finished honchoing a big airlift operation and I'm headin' back to Scotch AFB to head up another," boasted El Lobo.

"I just chatted with the crew, Major Terror, and it's going to be a long flight — a little over eight hours. The pilot said something about strong headwinds across the Atlantic," explained the nurse.

"I'm sure you and I can find something to pass away the long hours," invited C. R., his grin now becoming a familiar leer.

"But, Major Terror," cooed the nurse, "I wouldn't think of trying to replace your two Spanish girl friends so soon. After all, you always did say loyalty was one of your rare qualities."

Wind a few feet above the runway may tell you more than you think if there's a thunderstorm in the area.

The Way The Winds Blow

The pilot struggled to keep the aircraft's wings level as it neared the threshold on a gusty, final approach. Suddenly, the big bird began sinking and the pilot jammed the throttles home.

But the gusts won. The aircraft landed short of the runway and was badly damaged.

A case of altitude misjudgment by the pilot? Misjudgment, perhaps, but not concerning altitude. Without realizing it, this pilot had bucked wind gusts of up to 65 knots, much higher than gusts on the deck. And he wasn't even near a thunderstorm.

Gusty winds preceding thunderstorms have long been a hazard to flight, but until recently no one seemed to know just how hazardous.

Drastic wind changes may occur up to ten miles ahead of thunderstorms, with gusts of up to 100 knots. That's the word from Air Weather Service. The Air Force considers the phenomenon so serious that detailed information on it will be included in the next revision of AFM 105-5, Weather for Aircrews.

Here's basically what happens: First, gust wind speed is the sum of the thunderstorm downdraft speed and forward motion of the thunderstorm. The first gust is often the strongest. In extreme cases, first gusts may be as high as 100 knots and can affect aircraft up to 6,500 feet from the surface. Although the 100 knot gust is unusual, winds of 40 to 60 knots are common.

What's more, there are hidden factors in the gust criteria, factors that could make a lot of difference in aircraft control during takeoff and landing. For instance, wind speed may increase by as much as 50 percent between the surface and 1,500 feet, with the largest increase coming during the first 150 feet. This means that, since airport weather reports are taken at ground level, you could experience much higher winds during an approach than the weather report leads you to believe.

Tests have also shown that first gusts usually vary greatly in direction. Gusts associated with severe thunderstorms changed directions by more than 90 degrees over half the time during the tests.

The first gust phenomenon is particularly critical at threshold altitude, and the weather soothsayers have only one bit of advice concerning this: Don't try to beat an approaching thunderstorm if you're thinking of taking off or landing.

No one is suggesting that you delay landing every time a thunderstorm is reported at ten miles or less from the field. But there are measures that can be taken to keep clear of the first gusts. Determine which direction the storm is moving — and how fast. Keep a running knowledge of winds at and near your destination. If the bumper is moving toward the field and the winds are increasing, you're likely to have landing problems.

And when you get on final, be sure you keep a running account of wind speed and direction. Don't neglect any aspect or you could come up short.

Ailing Aircraft Commander

Shortly before takeoff roll, the aircraft commander of the four-engine jet complained of feeling ill. Since the copilot was scheduled to make the takeoff, the crew decided to depart as planned. After the plane became airborne, the pilot again complained that he didn't feel well and decided to walk around in the back of the aircraft. After reaching the rear of the aircraft, the pilot told an accompanying crew member that he felt unsure of his surroundings. Returning to his seat, he then began breathing oxygen but appeared confused and unaware of what was going on around him. In spite of his condition, he realized the gravity of the situation and directed the copilot to abort the mission. The copilot landed the aircraft, and shortly afterward the pilot went to the flight surgeon and underwent a complete physical examination. Laboratory tests were conducted and the pilot was grounded pending the outcome of the tests.

Copilots often feel redundant serving as the pilot "not in charge." But there have been many instances, such as this one, in which the second in command has played a vital role — a good reason for MAC's copilots to stay on their toes.

Taped Up

A T-29 entered a 500-foot overcast shortly after takeoff. To the pilot's horror, neither altimeter reflected any change from field elevation. The pilots continued the climb, using attitude and power instruments as climb references. When the copilot selected his alternate static pressure source, his altimeter, vertical velocity, and airspeed indicator appeared to respond properly.

Breaking out of the weather at 3,500 feet, the pilot contacted approach control and requested an airborne intercept. A Navy S-2 joined up and verified the reliability of the alternate static source. Following the rendezvous, the T-29 flew a normal PAR and landed without further incident.

What had happened? An AIMS altimeter had been recently installed and calibration procedures called for taping external static ports with cellulose tape. Before completion of the modification, the old shift change trick intervened and the cellulose tape was forgotten. Four people with checklists — installer, inspector, aircraft commander, and copilot — overlooked the tape.

Unless flight crews remember to check those tiny holes during preflight, instruments may speak with forked tongues in flight. And don't forget, oil, grease, dirt, and the like can plug up these ports, too.

Thump at the Bottom of the Slide

The commercial contract carrier aborted with its right landing gear smoking and the crew prepared to evacuate the plane load of passengers.

Complying with company policy, the two able bodied men sitting in seats near the emergency exits left the aircraft and took up positions on each side of the evacuation chute. Unfortunately for the other passengers, the Air Force Security Police arrived and insisted that the two men move away from the aircraft for their own safety. Within a few minutes, the evacuating passengers, some of them women with babies in their arms, jumped into the chute — without safety guards at the bottom — and some landed not-too-gently on the ramp. Amazingly enough, no one was injured. But they might have been.

Since THE MAC FLYER isn't normally distributed to Security Police units, perhaps unit safety officers can provide them a copy of this issue. The MAC Safety Directorate has determined that the procedure of stationing two men at the bottom of escape chutes during emergency egress is acceptable. In short, Security Police should have let the two men hold the chute until everyone had evacuated the plane.

TS Ups and DOWNS

A twin-engine airliner, in the midst of severe thunderstorms, heavy rain, strong winds, and roll clouds, approached its destination. The pilots received radar vectors around the worst cells and approach control advised the pilot that heavy rain showers were moving across the approach end of the runway. The crew acknowledged and confirmed that they could see the showers. Shortly after the aircraft departed the outer marker inbound, heavy rain engulfed the aircraft and it crashed moments later into a residential area two miles short of the runway. Investigators determined that the aircraft crashed because of the severe downdrafts in the heavy rain. Lightning strikes were evident on the wreckage, although it apparently hadn't affected the vital components of the aircraft.

Most pilots shy away from enroute thunderstorms, but sometimes will penetrate heavy rain to reach the sanctity of a runway. If you're confronted with such a choice, it would be much wiser to hold for a few minutes until the airport opens up.

O_2 Vanished Into Thin Air

Flying toward an island base the WB-57F pilot noticed, during a periodic cockpit check, that his right oxygen converter was almost empty. He turned back toward home base, but it wasn't long before the converter dumped its remaining supply. At about the same time, the navigator complained that he wasn't getting oxygen from either the right or the left converter. He was in an unhealthy situation by now and becoming hypoxic, so the pilot declared an emergency and started a descent. Both crew men pulled their emergency cylinder green apples to provide oxygen during descent. The plane leveled at FL 250 and the crew maintained cabin pressure at 10,000 feet for the rest of the flight.

The oxygen loss was traced to the right converter ship-to-kit connection. The spring mechanism which should have held the leads together failed to maintain proper tension. While the navigator was trying to draw from the right converter, he was sucking on some pretty thin cabin air.

Qs

Escaping Ladder

As the Starlifter climbed through 6,500 feet the crew was startled as the number two emergency escape hatch blew open. A crew member tried to release the rope escape ladder near the hatch so he could get a close look. He pulled the T-handle to release the ladder, but instead of the ladder falling to the cabin floor, it was sucked out of the hatch. With the hatch open and a rope ladder banging against the top of the fuselage, the AC decided to return to base. The scanner managed to get the ladder back inside the aircraft but not before the damage was done.

A hole was punctured in the fuselage and the hatch was also damaged. While the faulty hatch lock mechanism could not be foretold by the crew, the crew did have control over the escape ladder release. Remember, when an escape hatch is opened during flight more than air could leave the aircraft.

Ghost Riders in the Sky

The following story was excerpted from "Flight Safety Facts and Analysis," a publication of the Flight Safety Foundation. The incident was written up in the log book of the aircraft involved. Whether it is related to flight safety is something for our readers to decide.

One of the flight attendants was in the lower galley of the jumbo when, in the course of her duties, she happened to glance into the glass window of one of the ovens or meal heating units. There, looking out at her (or was it a reflection?), was the face of the flight engineer who had lost his life in the Everglades crash of one of the airline's trijets several months earlier. He had been below, checking the position of the jumbo's nose gear, when the big trijet slammed into the marsh.

The mystified and not unstartled flight attendant "went topside" and asked another stewardess to go below. She did . . . and verified what the first girl had seen. They then asked the flight engineer of their flight to go below. He did . . . and he not only saw but he talked to the vision, or ghost if you will, who said, "Watch out for a fire on this airplane."

Shortly thereafter, a problem developed in one of its three engines after landing in Mexico City. The flight crew asked for and was given permission to make a two-engine ferry flight to the airline's maintenance base for an engine change.

On takeoff from Mexico City's airport, nearly a mile and a half above sea level, a fire developed in one of the big jumbo's two remaining engines. The engine had to be shut down. Only through the flight crew's almost unbelievable expertise in handling the big jet were they able to come around at no higher than 400 feet AGL, and land safely on one engine.

after deadline . . .

HOT BATTERY -- Some of you Huey drivers are discovering overheated batteries lately and the nickel cadmium type is the culprit. A series of events causes shorting, overflowing, and sometimes even failure. This apparently is being caused when low capacity batteries are overcharged. When they charge at an excessive rate, they get hot. Improper maintenance may set a battery up for such a condition. A cure is in the making but, meanwhile, there are helpful measures we can take. Step one is to follow prescribed technical order procedures when maintaining a battery. Crews should use auxiliary power carts for engine starts and maintenance checks. No aux power cart available at your remote missile site? Then use caution and watch the battery load carefully for significant deviations, or check those unusual odors. These may be telling you that your battery is getting hot.

NEXT MONTH -- Feature articles next month include:

* The Homecoming -- A MAC aircraft commander recalls his trips to Hanoi to fly out the American POWs. He talks of the joy in returning the prisoners to freedom.

* A Queen of the Sky -- The C-74 is examined in its role as cargo workhorse during the late 1940s and the early 1950s. Forerunner of the C-124, it had an enviable safety record during its nine years of flying, with no crashes or fatalities.

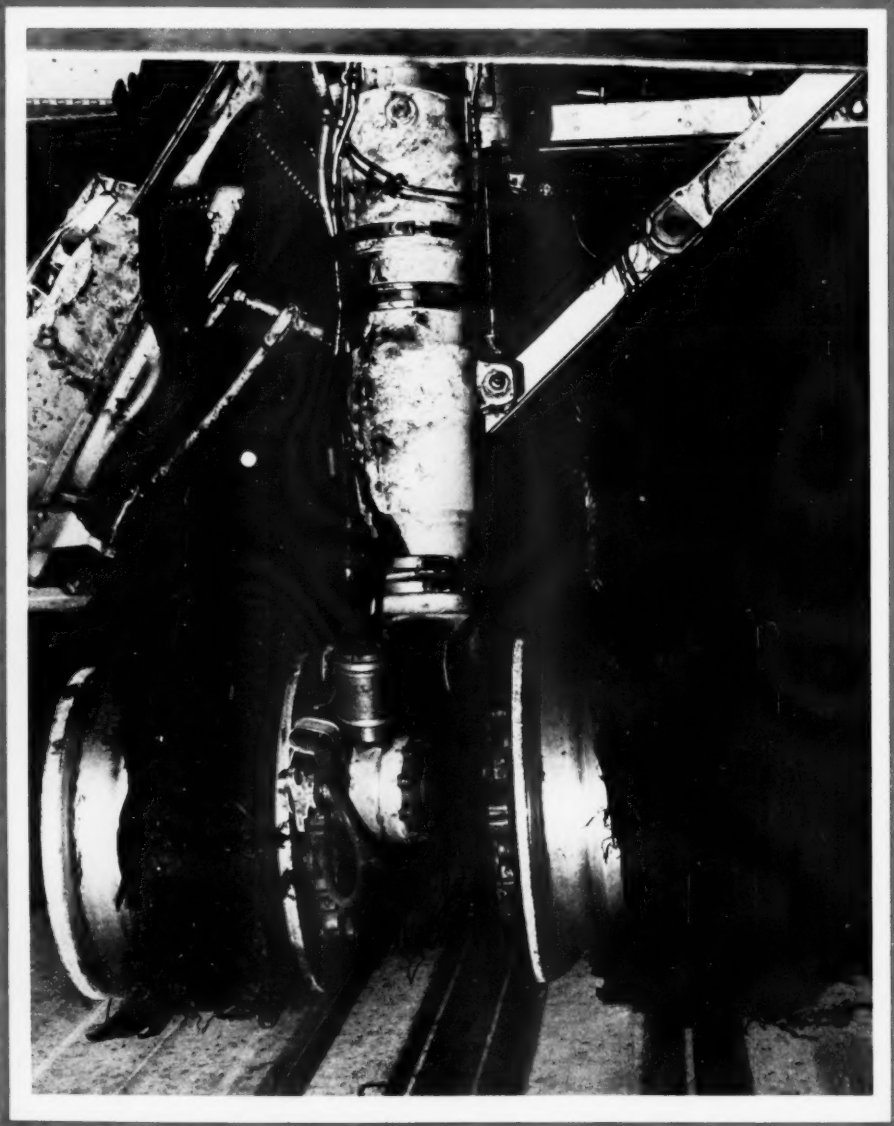
* Fowl Skies -- A look at the bird strike hazard and some defensive measures to cut down the collision potential.

* Speaking of Winter -- An unusual look at the approaching winter weather as seen through the eyes of the aircraft. Review cold weather procedures now to be ready for your aircraft's first sniffle.

* Togetherness in Air and Ground Training -- A look at the crew that trains together. How safety can be enhanced through teamwork and close collaboration.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1974-665-144/1

Touch and Go



TAXI CHECKLIST: "BRAKES CHECKED."